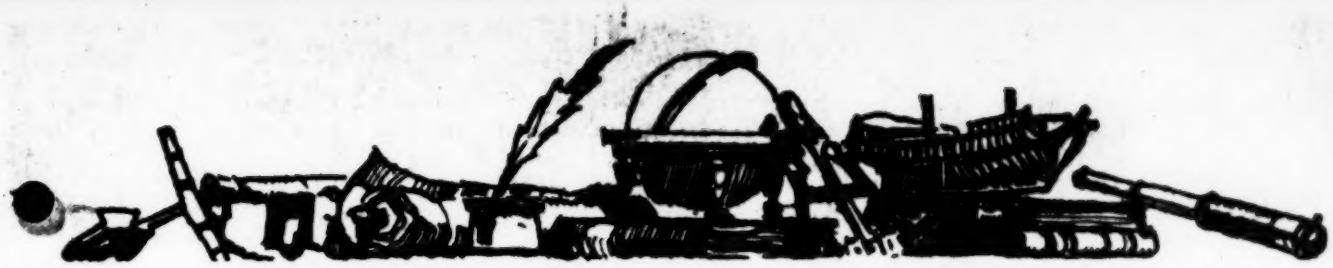

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BRIEF DESCRIPTION OF THE EARLY INSTRUMENTS EMPLOYED FOR CELESTIAL NAVIGATON

L. A. HARDING (N. R. G.)

CELESTIAL NAVIGATION BY SEA OR AIR LARGELY DEPENDS UPON THE ABILITY OF THE NAVIGATOR TO ASCERTAIN THE CORRECT ALTITUDE OF CELESTIAL BODIES ABOVE THE CELESTIAL HORIZON AND THE "KNOW HOW" TO USE THE INSTRUMENTS PROVIDED FOR THIS PURPOSE.

THE FOLLOWING DESCRIPTION OF ANGLE MEASURING INSTRUMENTS THAT HAVE BEEN USED BY NAVIGATORS SINCE THE TIME THEY WERE FIRST COGNIZANT OF THE FACT THAT THEY COULD EMPLOY THE SIGN POSTS IN THE SKY FOR FINDING THEIR WAY AROUND THE SEAS AND OCEANS, COMPRISE ABOUT ALL OF THE KNOWN INSTRUMENTS EMPLOYED FOR THIS USEFUL PURPOSE. INSTRUMENTS, THEODOLITES AND TRANSITS, PRIMARILY DESIGNED FOR LAND USE (SURVEYING AND ASTRONOMY) ARE NOT WELL SUITED FOR USE ON THE UNSTABLE DECK OF A VESSEL AT SEA. THE DESCRIPTIONS GIVEN WERE FOR THE MOST PART TAKEN FROM OLD TREATISES ON NAVIGATION FROM THE WRITER'S PERSONAL LIBRARY AND PRINCIPALLY FROM A TREATISE BY SIR JONAS MOORE, 1681.

ANGLE MEASURING INSTRUMENTS EMPLOYED BY THE EARLY MARINERS MAY BE DIVIDED INTO TWO CLASSES, VIZ: (1) THOSE BY WHICH THE OBSERVER VIEWS ONLY THE CELESTIAL BODY, (2) THOSE IN WHICH THE OBSERVER VIEWS SIMULTANEOUSLY BOTH THE CELESTIAL BODY AND THE HORIZON TO FIND ITS ALTITUDE.

FIG. 1 - THE ASTROLABE. DERIVED FROM THE TWO GREEK WORDS "STAR" AND "TAKE", WAS FIRST DESCRIBED BY JOANNES PHILOPONUS, GREEK PHILOSOPHER OF ALEXANDRIA, IN THE 6TH CENTURY. THE EARLY BABYLONIAN ASTRONOMERS, PROBABLY ORIGINATED AND USED THE INSTRUMENT LONG BEFORE THE GREEKS AS MODERN RESEARCH HAS DEVELOPED THE FACT THAT THESE EARLY PEOPLE WERE THE FIRST TO DIVIDE THE CIRCLE INTO 360 EQUAL PARTS, WE CALL DEGREES, FOR ANGULAR MEASUREMENTS AND MUST HAVE BEEN PROVIDED WITH SOME INSTRUMENT FOR MEASURING ALTITUDE AS THEY CATALOGUED AND CLASSIFIED STARS FOR A PERIOD OF OVER 300 YEARS. THEY FURTHER DIVIDED THE DEGREE INTO 60 EQUAL PARTS, WE TERM MINUTES OF ARC. THE PRACTICAL BABYLONIANS DEVELOPED A NUMERICAL SYSTEM BASED ON A UNIT OF 60 WHICH IS EVENLY FACTORED BY 1, 2, 3, 4, 5, 6, 10, 15, 20, 30 AND ITSELF, A FAR MORE PRACTICAL UNIT THAN OUR MODERN SYSTEM BASED ON A UNIT OF 10 WHICH CAN ONLY BE FACTORED BY 1, 2, 5 AND ITSELF. THIS INSTRUMENT, IN STATIONARY FORM, WAS THE FIRST SCIENTIFIC INSTRUMENT DEVELOPED BY MAN AND WAS EMPLOYED IN THE ANCIENT OBSERVATORIES, FOR CENTURIES, FOR MEASURING THE ALTITUDE OF CELESTIAL BODIES.

SO IT REMAINED UNTIL SOME PRACTICAL MINDED ARAB ABOUT 700 A.D. MADE IT PORTABLE (FIG. 1) BY SUSPENDING IT FROM A RING. THE ARABS USED IT FOR DETERMINING LATITUDE, POINTS OF THE COMPASS AND TIME. IT WAS THE FIRST ALTITUDE MEASURING INSTRUMENT USED BY NAVIGATORS AS EARLY AS 1290 AND IT IS KNOWN TO HAVE BEEN PART OF THE NAVIGATING EQUIPMENT OF COLUMBUS ON HIS EPOCH MAKING VOYAGE OF DISCOVERY IN 1492. IT HANGS BY ITS OWN WEIGHT, IN A PLUMB LINE DIRECTION OR 90° WITH THE CELESTIAL HORIZON OR HORIZONTAL PLANE OF OBSERVER.

IT IS MY SAD DUTY TO ANNOUNCE THE PASSING OF RICHARD E. LAWTON JANUARY 3, 1950. DICK WAS A CHARTER MEMBER OF THE GUILD AND SERVED ON THE BOARD. IN THE EARLY DAYS OF THE GUILD HE WAS VERY HELPFUL AND HIS ADVICE AND SPIRITED LETTERS REACHED US WEEKLY. ALTHOUGH HE HAS BEEN SICK FOR OVER A YEAR WE EXPECTED HIS RECOVERY AS WE THOUGHT HE WAS IMPROVING. ALTHOUGH HE WAS NOT ABLE TO WRITE US WE FELT HIS GOOD WILL AND KIND WISHES. WITH HIS RHODE ISLAND BACKGROUND AND SEA FARING ANCESTRY DICK LOVED HIS SHIPS AND WAS A STUDENT OF AMERICAN HISTORY. THE LAST SHIP HE WORKED ON WAS THE FIRST ENTERPRISE. WHEN A FELLOW MEETS A MAN LIKE DICK LAWTON THROUGH THE MAILS ONLY AND THEN LEARNS OF HIS SUDDEN DEATH HE REGRETS WITH ALL HIS HEART THAT HE NEVER SHOOK HIM BY THE HAND.

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THE INSTRUMENT COMPRISES A CIRCULAR METAL DISC GRADUATED IN DEGREES, AND IS PROVIDED WITH AN INDEX PIVOTED AT ITS CENTER UPON WHICH ARE PLACED TWO SIGHT HOLES THROUGH WHICH THE OBSERVATION IS MADE, THE ALTITUDE BEING MEASURED BY THE ANGLE BETWEEN THE INDEX AND THE HORIZONTAL LINE THROUGH THE CENTER OF INSTRUMENT. THE ANGLE MEASURED FOR OBSERVATION OF THE SUN'S ALTITUDE IS ORDINARILY BASED ON THE ELEVATION OF THE SUN'S UPPER RIM OR LIMB ABOVE THE HORIZON AND MUST BE CORRECTED BY SUBTRACTING THE SUN'S SEMI-DIAMETER OR 16 MINUTES OF ARC FROM THE ANGLE MEASURED.

THE SMALL CORRECTIONS NOW MADE FOR "REFRACTION" (THE BENDING OF THE SUN'S RAYS BY THE ATMOSPHERE) AND FOR "PARALLOX" BEING NEGLECTED BY THE USERS OF THE INSTRUMENTS HEREINAFTER DESCRIBED FOR THE SIMPLE REASON THAT THE NAVIGATOR DID NOT KNOW OF THEM AND IF HE HAD KNOWN, HIS MEASUREMENTS WERE TOO CRUDE TO MAKE ANY MATERIAL DIFFERENCE IN HIS CALCULATIONS.

THE PORTABLE ASTRALABE REQUIRED THE SERVICES OF THREE SAILORS TO MAKE AND RECORD THE MEASURED ALTITUDE, ONE TO HOLD THE INSTRUMENT, ONE TO TAKE THE SIGHT AND ONE TO READ AND RECORD THE ANGLE.

FIG. 2 – THE FORE OR CROSS STAFF. THE PORTUGUESE OR SPANIARDS PROBABLY INVENTED THIS INSTRUMENT AT AN EARLY DATE WHICH WAS TERMED THE "BALESTILHA" BY THEM. THIS INSTRUMENT CONSISTS OF A SQUARE STRAIGHT GRADUATED STAFF WHICH IS PROVIDED WITH FOUR SLIDING CROSSES OF DIFFERENT LENGTHS. THE DIFFERENT GRADUATIONS (IN DEGREES) EACH LOCATED ON ONE OF THE FOUR SIDES OF THE STAFF ARE TO BE USED WITH EACH CROSS SEPARATELY. THE SHORTEST CROSS CALLED THE 10 CROSS BELONGS TO THE SCALE ON STAFF WHERE THE DIVISIONS BEGIN AT ABOUT 3° PROCEEDING TOWARDS THE EYE END TO 10°. THE NEXT LONGEST CROSS (30 CROSS) BELONGS WITH THAT SIDE OF THE STAFF WHERE THE DIVISIONS BEGIN AT 10° AND END AT 30°. THE NEXT LONGEST CROSS IS CALLED THE 60 CROSS AND BELONGS WITH THE SIDE OF STAFF WHERE THE DIVISIONS BEGIN AT 20° AND END AT 60°. THE LONGEST CROSS, CALLED THE 90 CROSS, BELONGS WITH THAT SIDE OF STAFF WHERE THE DIVISIONS BEGIN AT 30° AND END AT 90°.

IN OPERATION ONE END OF THE STAFF IS PLACED AT THE CORNER OF THE EYE WITH ONE OF THE CROSSES ON THE STAFF. LOOK AT THE SUN'S CENTER OVER THE UPPER END OF THE CROSS AND AT THE LOWER END FOR THE HORIZON. IF YOU SEE THE SKY INSTEAD OF THE HORIZON

DRAW THE CROSS ALONG STAFF A LITTLE NEARER TO YOUR EYE, BUT IF YOU SEE THE SEA INSTEAD OF THE HORIZON PUSH THE CROSS A LITTLE FURTHER FROM YOUR EYE AND SO CONTINUE MOVING THE CROSS UNTIL YOU SEE EXACTLY THE SUN'S CENTER BY THE TOP OF THE CROSS AND THE HORIZON BY THE LOWER END THEREOF. THE DEGREES AND MINUTES CUT BY THE INNER EDGE OF THE CROSS UPON THE SIDE OF THE STAFF PECULIAR TO THE CROSS YOU USE, IS THE ALTITUDE OF THE SUN. IF THE WEATHER BE HAZY THE FORE STAFF MAY BE USED AS INDICATED ABOVE BUT IF THE SUN SHINES OUT EITHER THE UPPER LIMB MUST BE OBSERVED INSTEAD OF ITS CENTER OR ELSE USE A COLORED GLASS ON THE TOP OF THE CROSS TO PROTECT THE EYE SIGHT FROM THE SUN'S BRIGHTNESS. IF THE UPPER LIMB OF SUN IS OBSERVED SUBTRACT 16' OR SUN'S SEMI-DIAMETER FROM THE MEASURED ANGLE.

THE SIDES OF THE STAFF MAY BE GRADUATED BY GRAPHICAL CONSTRUCTION OR BY CALCULATION, EMPLOYING TRIGONOMETRY. THUS GEOMETRICALLY DRAW THE HORIZONTAL LINE FG OF THE LENGTH OF STAFF TO BE GRADUATED AND AT E AND G RAISE THE PERPENDICULARS F C, D G LAYING THEREON THE LENGTH YOU INTEND FOR THE HALF LENGTH OF THE CROSS. DRAW C D REPRESENTING THE CROSS TO BE GRADUATED. THEN ON THE CENTER F DESCRIBE YOUR ARCH G H BEING ONE EIGHTH PART OF A CIRCLE AND DIVIDE IT INTO 90 EQUAL PARTS OR DEGREES. THEN FROM F DRAW STRAIGHT LINES THROUGH THESE POINTS, 10, 20, 30 ETC., WHICH SHALL DIVIDE THE LINE C D AS THE STAFF OUGHT TO BE GRADUATED.

THE FORESTAFF REMAINED IN USE FOR A LONG TIME AND PRACTICALLY DISPLACED THE PORTABLE ASTRALABE AS AN ANGLE MEASURING INSTRUMENT AT SEA. IT, IN TURN, WAS DISPLACED BY THE BACKSTAFF AS THE STANDARD ANGLE MEASURING INSTRUMENT. FROM THE MEASURED ALTITUDE MUST BE SUBTRACTED THE MINUTES GIVEN BY THE "LITTLE TABLE" CORRESPONDING TO THE HEIGHT OF EYE ABOVE THE HORIZON. THIS CORRECTION IS TO BE APPLIED FOR ALL INSTRUMENTS EMPLOYING THE HORIZON FOR ONE OF THE SIGHTS.

FIG. 3 – The Demi-Cross. THIS INSTRUMENT WAS SOMETIMES USED BY THE DUTCH, BUT HAS BEEN WHOLLY NEGLECTED BY THE ENGLISH, WE PREFERRING THE WHOLE STAFF OR FORESTAFF. (THOMAS MOORE). THE STAFF IS EASILY GRADUATED BY THE GRAPHICAL METHOD AS USED FOR THE FORESTAFF. A IS THE HORIZON VANE, H THE SIGHT VANE AND E THE SHADE VANE. HOLD THE INSTRUMENT UPRIGHT AND LOOKING THROUGH THE SIGHT VANE SEE THE HORIZON THROUGH THE SLIT IN THE HORIZON VANE BY SLIDING THE TRANSUM OR CROSS TO AND FRO UNTIL YOU SEE THE SHADE OF THE VANE E FALL AT THE SAME TIME UPON THE UPPER PART OF SLIT IN THE HORIZON VANE. THERE ARE THE DEGREES CUT ON THE STAFF BY THE TRANSUM, THE ALTITUDE OF THE SUN REQUIRED. CORRECT THIS READING FOR HEIGHT OF EYE ABOVE HORIZON AND FOR THE SUN'S SEMI-DIAMETER AS WITH THE FORESTAFF.

FIG. 4 – The Bow. D. E. C. IS A 90° ARCH DRAWN WITH A RADIUS OF A. D. A. E. IS THE STAFF, F THE SHADE VANE, G THE SIGHT VANE PLACED AT THE CENTER LINE OF THE ARCH, AND B THE HORIZON VANE WITH SLIT. IN USE THE INSTRUMENT IS HELD UPRIGHT BY THE VERTICAL PIECE D C. SET THE SHADE VANE ORDINARILY AT ABOUT 25° FOR TRIAL, THEN MOVE THE SIGHT VANE UP AND DOWN ALL THE WHILE LOOKING THROUGH THE SIGHT VANE G, UNTIL YOU SEE THE SHADE OF THE UPPER EDGE OF THE SHADE VANE F ON THE SLIT IN THE HORIZON VANE B, AND AT THE SAME TIME YOU ALSO SEE THE HORIZON THROUGH THE SLIT. IF YOU SEE THE SKY AND NOT THE HORIZON THEN DRAW THE SIGHT VANE A LITTLE LOWER TOWARD C BUT IF YOU SEE THE SEA INSTEAD OF THE HORIZON THEN SLIDE THE SIGHT VANE UPWARD. THE MEASURED ALTITUDE OF THE SUN'S UPPER LIMB IS THE DIFFERENCE BETWEEN THE DEGREES CUT BY SIGHT VANE AND THE UPPER EDGE OF SHADE VANE. CORRECT THE MEASURED ALTITUDE BY THE SUN'S SEMI-DIAMETER AND HEIGHT OF OBSERVER'S EYE ABOVE HORIZON.

FIG. 5 – The Plough. THE FOLLOWING DESCRIPTION IS GIVEN VERBATIM AS SIR THOMAS MOORE WROTE IT IN 1681. "THIS INSTRUMENT IS ANCIENT THOUGH NOT NOW MUCH USED. IT CONSISTS OF A STAFF A I.G, SMALL ARCH H L, CROSS F K AND THREE VANES (VIZ.). A AN HORIZON VANE, B A SHADE VANE, AND C A SIGHT VANE TO MOVE UPON THE STAFF. THIS WILL SUPPLY (APPLY TO) MANY INSTRUMENTS, EVEN ALL THAT HAS BEEN BEFORE MENTIONED, BUT HERE I WILL SHEW ONLY ITS PROPER USE AS A DIFFERENT AND DISTINCT INSTRUMENT FROM THE OTHER (S)". "TO OBSERVE THE SUN'S ALTITUDE WITH IT – FIT ON THE HORIZON VANE, AND PLACE THE SHADE VANE TO ANY DEGREE AT PLEASURE, SO IT EXCEED NOT THE (SUN'S) ALTITUDE

THE EARLY INSTRUMENTS EMPLOYED FOR CELESTIAL NAVIGATION

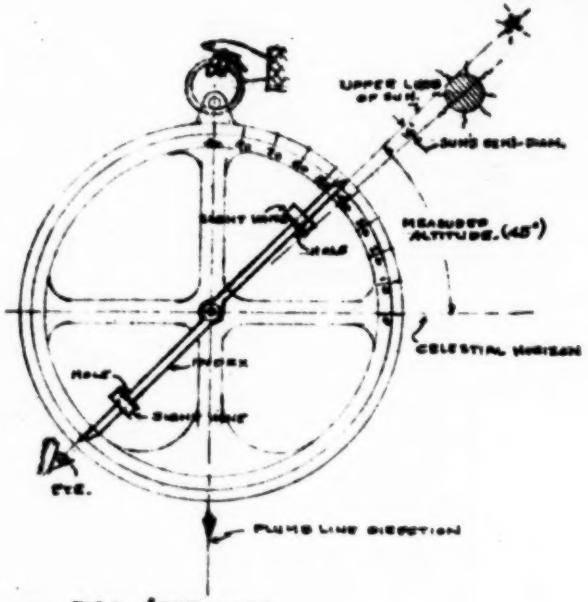


FIG.1 ASTROLABE.

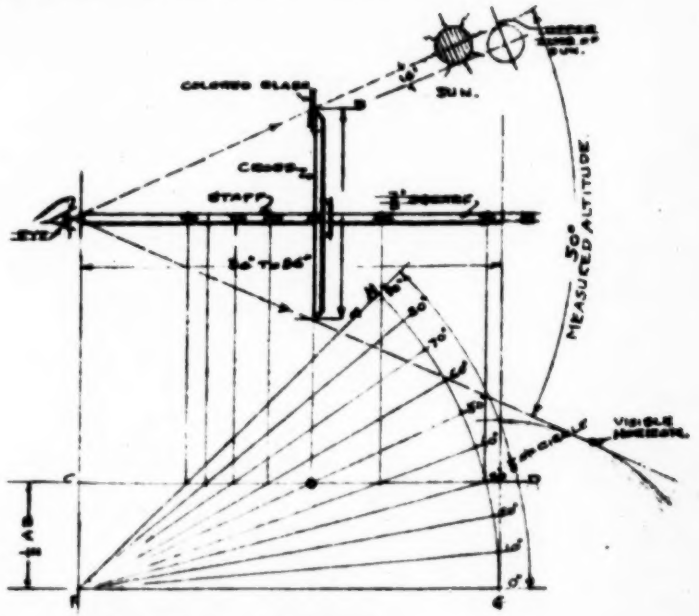


FIG.2 CROSS STAFF OR BACKSTAFF.

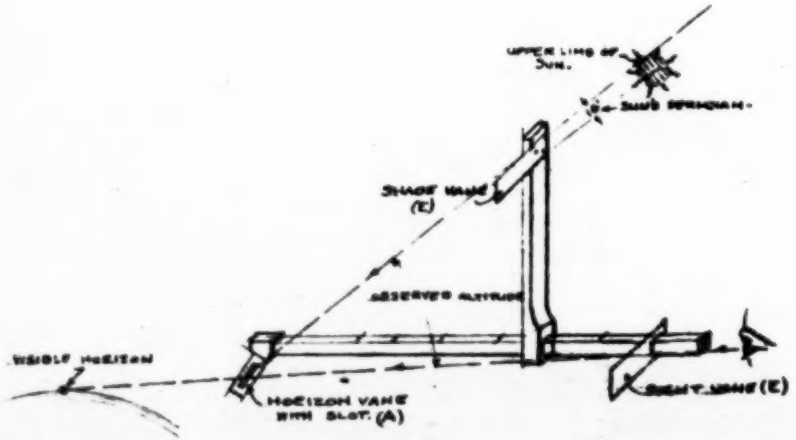


FIG.3 DEMI-CROSS.

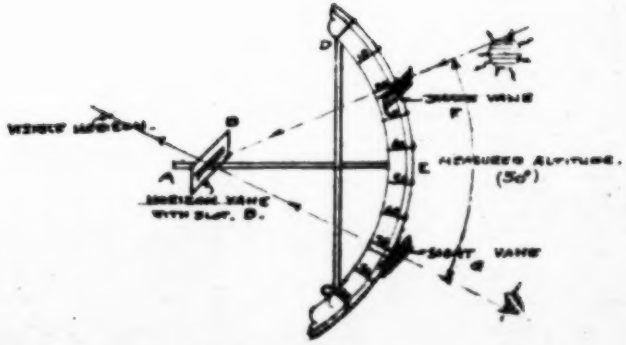


FIG.4. BOW.

THE EARLY INSTRUMENTS EMPLOYED FOR CELESTIAL NAVIGATION

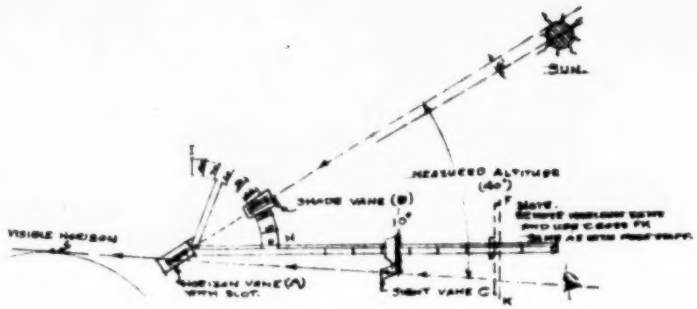


Fig.5. Plough

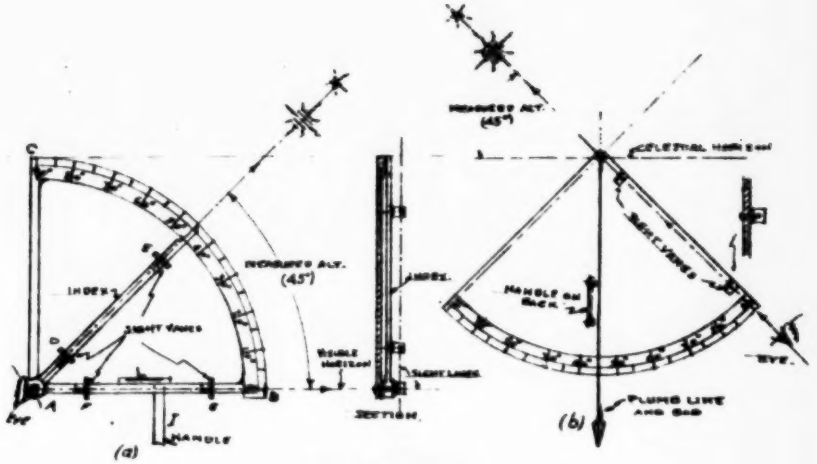


Fig.6. Quadrants.

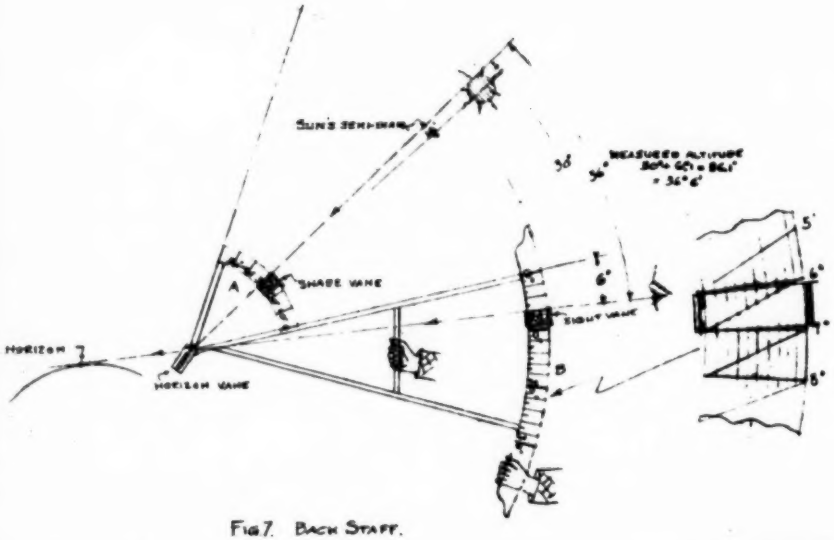
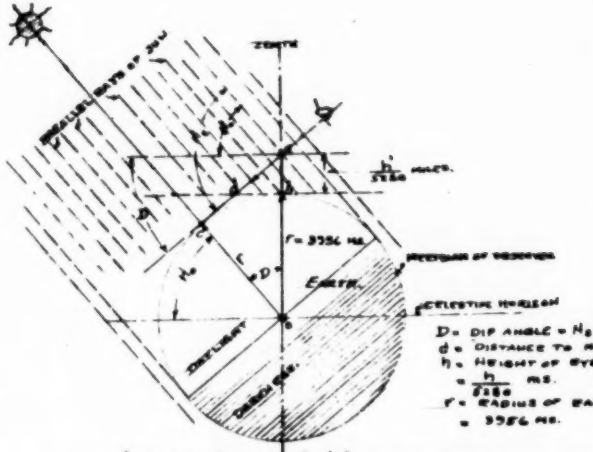


Fig.7. Back Staff.


ZENITH
CELESTIAL HORIZON
r = 3956 MS.
EARTH.
D° DIP ANGLE = Hs - Ho
d = DISTANCE TO HORIZON, MS.
h = HEIGHT OF EYE ABOVE SEA. Ft
= h/2280 MS.
r = RADIUS OF EARTH. MS
= 3956 MS.

$d^2 = (r+h)^2 - r^2 = 2rh + h^2$ (h^2 is very small compared with $2rh$ = nearly)

$\therefore d^2 = \sqrt{2rh/2280}$ or $d = 1.224\sqrt{h}$ miles.

$\tan D = \frac{d}{r} = \frac{1.224\sqrt{h}}{3956} = .000309\sqrt{h}$

Fig.8 Correction for Dip.

TO BE OBSERVED, NOR BE ABOVE TEN DEGREES LESS (WHICH MAY INDIFFERENT WELL BE JUDGED BY THE EYE;) FOR IN BOTH THESE CASES THE DIVISIONS ON THE STAFF ARE DEFICIENT; THEN PUT THE SIGHT VANE ON THE STAFF HOLDING UP THE INSTRUMENT, AND TURNING THE BASK OF THE ARCH TO THE SUN, MOVE THE SIGHT VANE ON THE STAFF BACKWARD AND FORWARD 'TILL THE SHADE OF THE UPPER EDGE OF SHADE VANE FALL ON THE UPPER PART OF THE SLIT IN THE HORIZON VANE, AND THAT AT THE SAME TIME LOOKING THROUGH THE SIGHT VANE YOU MAY SEE THE HORIZON THROUGH THE HORIZON VANE AS ABOVE DIRECTED IN THE USE OF THE BOW, THERE WILL THE SUM OF DEGREES ON THE ARCH AND ON THE STAFF BE THE SUN'S ALTITUDE ALLOWING FOR THE HEIGHT ABOVE THE HORIZON, AND FOR REFRACTION. IF IN OBSERVING, YOU SEE THE SEA INSTEAD OF THE HORIZON THEN MOVE THE SIGHT VANE TOWARD THE ARCH; BUT IF ON THE CONTRARY YOU SEE THE SKY AND NOT THE HORIZON, THEN DRAW THE SIGHT VANE BACKWARDS FROM THE ARCH". THE CROSS F K SERVES BY TAKING THE HORIZON VANE OFF, AND SETTING THE END OF THE STAFF A TO YOUR EYE, TO FIND THE ALTITUDE WITH, AFTER THE MANNER OF THE CROSS STAFF".

FIG. 6 – THE QUADRANT. THE ARC OR LIMB IS A QUARTER OF A CIRCLE GRADUATED IN DEGREES PROVIDED WITH A MOVEABLE INDEX WHEREON ARE TWO SIGHTS WITH HOLES THROUGH WHICH THE CELESTIAL BODY IS VIEWED. THERE ARE ALSO TWO SIGHTS FIXED ON LOWER EDGE OF THE QUADRANT THROUGH WHICH THE HORIZON IS SEEN. A IS THE CENTER, A B AND A C THE TWO SIDES, B C THE LIMB, D E TWO SIGHTS FIXED UPON THE MOVEABLE INDEX OR LABEL AND F G THE TWO OTHER SIGHTS FOR OBSERVING THE HORIZON. I IS THE HANDLE. IN OPERATION HOLD THE QUADRANT AS UPRIGHT AS YOU CAN BY THE HANDLE, TURN THE LIMB TO THE SUN AND LOOK THROUGH THE SIGHTS F G, MOVING THE INSTRUMENT TO AND FRO UNTIL YOU CAN SEE THE HORIZON THROUGH THEM, THEN MOVE THE INDEX HIGHER OR LOWER UNTIL THE BRIGHT SPOT COMING THROUGH D FALLS UPON E THEN SHALL THE ARC H B BE THE SUN'S ALTITUDE ALLOWING FOR REFRACTION AND FOR THE HEIGHT OF OBSERVERS EYE ABOVE THE HORIZON. THE QUADRANT MAY BE PROVIDED WITH A LIQUID LEVEL L ON THE LOWER EDGE (TO BE USED IN PLACE OF SIGHTS F G) TO ESTABLISH THE HORIZONTAL PLANE OF THE OBSERVER. IN THIS CASE THERE IS NO CORRECTION TO BE APPLIED FOR "HEIGHT OF EYE" OF OBSERVER.

A QUADRANT MAY ALSO BE SUPPLIED WITH A PLUMB LINE AND BOB IN PLACE OF A LEVEL FOR ESTABLISHING THE HORIZONTAL PLANE OF THE OBSERVER. THE PLUMB LINE BEING PERPENDICULAR TO THIS PLANE. FIG. 6-B. THIS QUADRANT IS PROVIDED WITH TWO SIGHTS ALONG ONE EDGE FOR VIEWING THE CELESTIAL BODY AS INDICATED AND WAS CONSIDERED AS BEING MORE ACCURATE THAN THE ASTROLOBE AND WAS ORDINARILY CONSTRUCTED OF A BRASS PLATE SIMILAR TO THE QUADRANT SHOWN IN THE MARINERS' MUSEUM AT NEWPORT NEWS, VA., MADE IN 1657. THE ALTITUDE IS INDICATED BY THE PLUMB BOB LINE WHEN THE BODY IS OBSERVED THROUGH THE SIGHTS. THERE IS NO CORRECTION TO BE APPLIED FOR "HEIGHT OF EYE". THIS INSTRUMENT REQUIRES THE SERVICES OF TWO SEAMEN, ONE TO TAKE THE SIGHT AND ONE TO READ AND RECORD THE ANGLE MEASURED.

FIG. 7 – BACK STAFF. WAS DEVISED BY JOHN DAVIS, IN 1590, ABLE NAVIGATOR AFTER WHOM DAVIS STRAIT IS NAMED WHEN HE WAS SEEKING A NORTHERN PASSAGE AROUND THE AMERICAN CONTINENT. IT RETAINED THE GOOD FEATURES OF THE BOW AND PLOUGH AND SOON BECAME THE STANDARD OBSERVING INSTRUMENT WITH NAVIGATORS.

IT WAS EMPLOYED FOR A PERIOD OF ABOUT 200 YEARS AND UNTIL THE ADVENT OF THE MODERN SEXTANT IN 1730-31. THE BACK STAFF IS PROVIDED WITH TWO ARCHES A AND B. THE LESSER ARCH A IS GRADUATED INTO 60 EVEN DEGREES AND THE LARGER B IN 30 DEGREES AS SHOWN. IN OPERATION THE OBSERVER STANDS WITH HIS BACK TO THE SUN PLACING THE SHADE VANE AT SOME EVEN DEGREE ON A. THE INSTRUMENT HELD IN AN UPRIGHT POSITION BY THE VERTICAL BAR IS SWUNG VERTICALLY AND MOVED TO THE RIGHT OR LEFT UNTIL THE SHADOW OF THE UPPER EDGE OF SHADE VANE FALLS SQUARELY ON THE UPPER EDGE OF SLOT IN THE HORIZON VANE. KEEPING THE SHADOW IN THIS POSITION, NEXT MOVE THE SIGHT VANE UP OR DOWN ON ARCH B UNTIL YOU SEE THE HORIZON THROUGH THE SIGHT VANE AND SLIT. THE SUM OF THE READINGS ON ARCS A AND B IS THE ALTITUDE OF THE OBSERVED SUN. FROM THIS SUM MUST BE DEDUCTED 16' FOR THE SUN'S SEMI-DIAMETER AND THE CORRECTION FOR HEIGHT OF THE OBSERVERS EYE ABOVE THE APPARENT HORIZON.

THE LARGER ARC B IS PROVIDED WITH A KIND OF "VERNIER" WHICH PERMITS THE OBSERVER TO DETERMINE ALTITUDES TO TENTHS OF A DEGREE OR ABOUT 6 MINUTES OF ARC. THIS KIND OF "VERNIER" WAS EMPLOYED BY TYCHO BRAKE AND JOHANNES KEPLER IN THE DANISH OBSERVATORY ON THE ISLAND OF HOENNA IN THEIR LARGE STATIONARY QUADRANTS, ONE OF WHICH HAD A RADIUS OF 19 FEET. (1586). A DIAGONAL LINE IS DRAWN BETWEEN EACH DEGREE DIVISION OF ARC B WHICH CUTS 10 EQUALLY SPACED, CONCENTRIC CIRCLES AS INDICATED. THE INTERSECTION OF THE DIAGONAL LINE WITH THE CIRCLE CLEARLY INDICATE THE DIVISION OF ONE DEGREE INTO TENTHS. THIS SCHEME WAS USED UNTIL THE INVENTION WE USE TODAY, BY PIERRE VERNIER (1580–1637) ON ALL MODERN ALTITUDE MEASURING INSTRUMENTS (THEODOLITES AND TRANSITS).

FIG. 8 – DIP ANGLE CORRECTION TO OBSERVED ALTITUDES. THE SUN IS LOCATED AT SUCH A GREAT DISTANCE FROM THE EARTH (93 MIL. MS.) THAT FOR ALL PRACTICAL PURPOSES THE RAYS REACHING THE EARTH MAY BE CONSIDERED PARALLEL. THE "DIP ANGLE" IS THE DIFFERENCE BETWEEN THE OBSERVED ANGLE H, BASED ON THE OBSERVED HORIZON AND THE TRUE ANGLE (Ho) BASED ON THE CELESTIAL HORIZON. IT IS COMPUTED BY COMBINING THE THEOREM OF PYTHOGRAS (582–500 B.C.) (WHICH STATES THAT THE SUM OF THE SQUARES OF THE SIDES OF A RIGHT ANGLE TRIANGLE IS EQUAL TO THE SQUARE OF THE HYPOTHENUSE) WITH THE TRIGONOMETRY OF HIPPARCHUS (146–126 B.C.) RESULTING IN THE FORMULA: TAU D EQUALS .000309 $\sqrt{H}$ FROM WHICH D IS FOUND, H BEING THE HEIGHT OF OBSERVER'S EYE ABOVE SEA LEVEL. THE FOLLOWING "LITTLE TABLE" BY SIR THOMAS MOORE GIVES, VERY NEARLY, THE SAME VALUES FOR D AS ARE IN USE TODAY.

MOORE'S "LITTLE TABLE" (1681)

H (FT.)	D MIN. OF ARC	H (FT.)	D MIN. OF ARC
3	2	24	5½
4	2	28	6
5	2½	32	6½
6	3	36	7
8	3	40	7
10	3½	44	7½
12	4	48	8
16	4		
20	5		

THESE INSTRUMENTS WERE EMPLOYED FOR THE DETERMINATION OF LATITUDE ONLY AS LONGITUDE AT SEA WAS CONSIDERED BEYOND THE ABILITY OF THE NAVIGATOR. HE WAS ABLE, BY THE SIMPLE PROCESS OF "SQUARE SAILING" TO FIND HIS WAY AROUND FAIRLY WELL, EMPLOYING LATITUDE DETERMINATIONS ONLY. THERE MAY BE SOME MEMBERS WHO WOULD LIKE TO MAKE REPRODUCTIONS OF THESE INSTRUMENTS FOR INCLUSION IN THEIR COLLECTION OF NAUTICAL LORE.

CAPTAIN BENJAMIN THOMPSON

FROM A LETTER OF HARRY E. ERSKINE

I WAS MUCH INTERESTED IN READING CAPTAIN LEIGHTON ROBINSON'S COMMENTS ON CAPTAIN COLCORD. I VISITED THE CAPTAIN AT HIS HOME IN SEARSPORT JUST A FEW MONTHS BEFORE HE DIED. WE WENT DOWN TO THE MUSEUM THERE AND HAD QUITE A GAM TOGETHER. HE HAD ALL THE PICTURES AND MANY PIECES OF GEAR THAT BELONGED TO CAPTAIN BENJAMIN THOMPSON, OF THE GREAT ADMIRAL ONE OF THE WELD FLEET. THEIR HOUSE FLAG WAS, AS I REMEMBER, A BLUE HORSE ON A WHITE FIELD.

CAPTAIN THOMPSON WAS A FINE OLD GENTLEMAN OF THE OLD SCHOOL. DURING THE CIVIL WAR HE WAS MASTER OF THE FAST CLIPPER SPORTSMAN WHICH WAS CHARTERED AS A POWDER SHIP FOR ADMIRAL D. G. FARRAGUT, AND SHE FOLLOWED THE FLAGSHIP HARTFORD THROUGHOUT THE ENTIRE CAMPAIGN. HIS WIFE WAS ARABELLA DUNHAM, DAUGHTER OF GEORGE DUNHAM, OWNER OF FRANKFORT (MINKHOLE) ME. SHIPYARD WHERE SOME OF THOSE LAST FINE CLIPPERS WERE TURNED OUT. I WAS BORN IN THE MINKHOLE AND CAPTAIN BEN'S GRANDDAUGHTER LIVED AT OUR HOUSE

WHILE HER MOTHER WAS AWAY IN A HOSPITAL. WE GREW UP TOGETHER AND I SPENT MANY HAPPY HOURS IN CAPTAIN THOMPSON'S HOME.

THE WALLS WERE COVERED WITH OILS OF SHIPS THE CAPTAIN HAD SKIPPERED, OLD ARMOR, SPEARS, SHIELDS, ARROWS, SWORDS, AND OTHER PIECES HE HAD PICKED UP ABROAD. GREAT TAPESTRY PIECES HUNG ON THE WALLS AND OLD TEAK CHESTS, BEAUTIFULLY CARVED, WERE IN EVERY ROOM AND A FRAMED LETTER OF COMMENDATION FROM ADMIRAL FARRAGUT HUNG ON THE LIVING ROOM WALL. THE HOUSE WAS A LARGE ONE OF BRICK, AND SAT UPON A HILL OVERLOOKING THE RIVER.

CAPTAIN THOMPSON HAD A PARROT WHICH WAS EIGHTY YEARS OLD AT THAT TIME AND IT SWORE LIKE A HELLION. THE CONGREGATIONAL CHURCH WAS A HEAVING LINE THROW AWAY AND ON SUNDAY MORNINGS THE BIRD WOULD OUTSCREECH THE PASTOR EVERY TIME.

MRS. THOMPSON WAS AN ELDERLY LADY WHEN I KNEW HER, BUT IT WAS NOT UNTIL I GOT TO TALKING WITH CAPTAIN COLCORD AND HE SHOWED ME AN OIL PAINTING OF HER, THAT I REALIZED WHAT A BEAUTY SHE MUST HAVE BEEN.

THE CAPTAIN WAS ENTRUSTED BY THE JAPANESE GOVERNMENT TO BRING OVER THE FAMOUS COLLECTION OF SWORDS WHICH ARE NOW IN THE BOSTON MUSEUM OF FINE ARTS. HE ONCE PICKLED AN ENGLISH NOBLEMAN WHO DIED OUT IN THE FAR EAST AND BROUGHT HIM BACK TO LONDON LASHED FORWARD OF THE MAIN MAST ON THE SPAR DECK. THEY HAD TOUGH GOING ALL THAT VOYAGE, AND THE CREW ON VERGE OF MUTINY ALL THE TIME ON ACCOUNT OF THE LIMEJUICE PASSENGER SWISHING AROUND IN HIGH GRADE ALCOHOL RIGHT IN THEIR MIDST. THEY DRAGGED HIM OUT AT LONDON TO SEE NO SWAP HAD BEEN MADE, AND THE FINE CONDITION HE WAS IN ON ARRIVAL WAS DULY NOTED BY THE LORDS AND A LETTER OF COMMENDATION WAS GIVEN THE CAPTAIN.

THE GREAT ADMIRAL SPENT HER LAST DAYS ON THE WEST COAST AND I HOPE THE AFTERGUARD MAY TELL ME SOMETHING ABOUT THIS FAMOUS SHIP AND WHERE HER BONES LIE. THOSE WERE GREAT DAYS FOR A LONG LEGGED KID WITH SEA FEVER IN HIS BONES, GIVEN THE CHANCE TO LEARN ABOUT THE SEVEN SEAS FROM THE LIPS OF A GRAND DAME WHO HAD BEEN THERE IN PERSON WITH HER CAPTAIN. MRS. THOMPSON SAILED AROUND CAPE STIFF SEVEN TIMES, AROUND THE WORLD THREE AND THROUGH THE STRAITS ONCE.

LOCATION OF TRUNNIONS ON THE MAYFLOWER GUNS

BY E. N. RICH

TRUNNIONS CAME INTO USE IN THE MIDDLE OF THE 15TH CENTURY. THEIR LOCATION VARIED FROM TIME TO TIME ACCORDING TO THE DIFFERENCE IN WEIGHT DESIGN AND THEORY ON HOW THE GUN SHOULD BE HUNG. THESE EARLY PIECES WILL BE FOUND TO ALWAYS BE "CENTER-HUNG"—THAT IS THEY EXTEND FROM THE SIDE OF THE SUN AT RIGHT ANGLES, WITH THE CENTER OF THE TRUNNION PASSING IN LINE WITH THE CENTER OF THE BORE.

ABOUT THE 16TH CENTURY THE DESIGN WAS CHANGED AND THE GUNS WERE QUARTER HUNG, THAT IS WITH THEIR AXIS BELOW THE CENTER OF THE GUN. THIS IS THE TYPE USED AT THE TIME OF THE MAYFLOWER AS IN MY PREVIOUS SKETCH. ALTHOUGH JOHN MULLER RECOMMENDED THE RETURN TO THE "CENTER HUNG" IN HIS BOOK DATED 1768, IT WILL BE FOUND THAT BOTH CENTER AND QUARTER HUNG WERE USED UNTIL ABOUT 1840, WHEN CENTER HUNG BECAME UNIVERSAL AND QUARTER HUNG ABANDONED.

THE CONSTITUTION'S GUNS OF 1798-1820 STILL SHOW AS BEING QUARTER HUNG. THE THEORY OF DESIGN WAS: (1) BELOW CENTER: — BEARS DOWN ON DECK AND CARRIAGE, DIMINISHING RECOIL BUT LIABLE TO BREAK CARRIAGE AND OVERSHOOT BY ITS UPPER ACTION AT MOUTH. (2) ABOVE CENTER: — TENDENCY TO RISE FROM CARRIAGE, UNDERSHOOT AND BREAK CARRIAGE. IN BOTH 1 AND 2 QUOINS WERE LIABLE TO FLY OUT AND INJURE CREW. (3) CENTER:—LESS DISTURBANCE TO FLIGHT OF SHOT AND EASIER ON CARRIAGE.

THE POSITION OF TRUNNIONS IN REGARD TO LENGTH OF GUN FROM BREACH TO MOUTH, NOT INCLUDING CASCABEL WAS FOUND BY STUDY TO DEPEND ON THE CENTER OF GRAVITY OF THE GUN. THIS VARIED ACCORDING TO WEIGHT, LENGTH AND THICKNESS OF METAL AT REINFORCEMENTS AT BREACH, NECK AND MOUTH. THE EXCESS IN WEIGHT AT BREACH WAS KNOWN AS THE "PREPONDERANCE" OR THE PRESSURE BORN BY THE QUOIN WHERE THE BREACH RESTED ON IT.

IT WAS FOUND THAT BY DIVIDING THE DISTANCE FROM THE CENTER OF GRAVITY TO THE MUZZLE INTO 21 PARTS AND PLACING THE AXIS OF THE TRUNNIONG 1/21 PART NEARER THE MUZZLE FROM THIS POINT OF CENTER OF GRAVITY, THAT A GREATER WEIGHT WAS GIVEN TO THE BREECH SECTION OF THE GUN.

IN 1643 THOS. SMITH (THE ART OF GUNNERY) GIVES HIS PROPORTION AS 3/7THS. OF THE TOTAL LENGTH FROM BREACH TO MUZZLE FOR THE LOCATION OF THE TRUNNION (APPROX. 43%). OTHER AUTHORS CLAIM 4/9THS AS A MORE CORRECT PROPORTION. SMITH ALSO STATES THAT GUNS WERE QUARTER HUNG AND TRUNNIONS WERE 1 CALIBRE IN DIAMETER IN LENGTH, BUT I FIND THIS VARIES IN EARLY GUNS TO A GREAT EXTENT.

ACCORDING TO MY DIMENSIONS THE MAYFLOWER SAKARET WAS 42.5% AND THE MINION 43.3% WHICH WOULD CHECK WITH SMITH VERY CLOSELY.

IT WILL BE FOUND THAT CARRONADES OF 1810-20 (WITH REGULAR TRUNNIONS WERE MOUNTED VERY CLOSE TO "THIRDS", WHILE THE 24 POUND BOW CHASERS WERE ABOUT 42% ON THE CONSTITUTION AT THAT TIME. POSSIBLY THE CAPTAIN MENTIONED BY MR. JOHN J. FLYNN WAS SPEAKING OF THE FORMER TYPE.

THE MARINE MUSEUM OF THE NEW YORK HISTORICAL SOCIETY

BY HARRY ECKSTEIN

IT IS TO BE REGRETTED THAT A MUSEUM WITH AS MUCH AVAILABLE SPACE AND SO ATTRACTIVE A SETTING HAS NOT AS YET ACQUIRED A WORTHY AND REPRESENTATIVE COLLECTION OF SHIP MODELS, BUT THAT FAILING WILL UNDOUBTEDLY OVERCOME WITH TIME AND AWAKENED INTEREST ON THE PART OF LOCAL MODELLERS. IT DOES, HOWEVER, POSSESS A FINE COLLECTION OF PICTURES AND PRINTS WHICH ARE OF GREAT VALUE AND INTEREST TO THE NAUTICAL-MINDED, AS WELL AS A SUPERB GROUP OF MARINALIA LOANED OR PRESENTED BY COLLECTORS AND DESCENDANTS OF MEN FAMOUS IN THE NAVAL ANNALS OF OUR COUNTRY. THE MAIN EXHIBITION ROOM IS ARRANGED TO REPRESENT THE DECK OF A 16TH CENTURY SHIP, WITH A FORECASTLE DECK AT ONE END, A MAST AND FIFE-RAILS IN THE CENTER, RAILINGS ALONG THE SIDES, AND A POOP WITH CABIN UNDERNEATH AT THE OTHER END.

SAN FRANCISCO MARITIME MUSEUM

MAYOR SUGGESTS HISTORIC SHIPS BE ENSHRINED HERE

MAYOR ELMER E. ROBINSON HAS PROPOSED AN AMBITIOUS PROJECT TO ENSHRINE THE MEMORY OF SAN FRANCISCO'S GLORIOUS MARITIME HISTORY.

THE GREAT SHIPS OF OLD AND THE MEN WHO SAILED THEM THROUGH THE GOLDEN GATE AND OVER THE SEVEN SEAS WOULD BE HONORED BY THE ESTABLISHMENT OF A UNIQUE MARITIME MUSEUM.

THE MAYOR HAS SUGGESTED THE MUSEUM BE LOCATED AT AQUATIC PARK AND THAT MANY OF THE OLD SAILING VESSELS CONNECTED WITH THE CITY'S SEAFARING HISTORY BE BROUGHT THERE AS PERMANENT EXHIBITS.

"MUCH OF THE HISTORY OF CALIFORNIA WAS WRITTEN BY GOLD HUNTERS, CHINESE AND IMMIGRANTS FROM ALL OVER THE WORLD WHO REACHED THIS GREAT STATE THROUGH THE GOLDEN GATE AND SAN FRANCISCO HARBOR," SAID THE MAYOR.

"THE HISTORIC EARLY DAYS OF SAN FRANCISCO'S WATERFRONT SHOULD BE PRESERVED. ONE OF THE BEST WAYS OF DOING THAT MIGHT BE TO BRING BACK PERMANENTLY THESE EARLY DAY PIONEER SHIPS."

MAYOR ROBINSON SAID AT LEAST FIVE OF THE FAMOUS EARLY DAY VESSELS, WHICH EITHER SAILED FROM HERE OR WERE BUILT HERE, ARE IN GOOD ENOUGH CONDITION TO BE RETURNED TO THEIR HOME PORT OF SAN FRANCISCO.

THEY INCLUDE SUCH NAMES AS THE "MATILDA," VETERAN SCOW SCHOONER; THE SQUARE RIGGER "KAIULANI"; THE "CITY OF PAPEETE," A MAIL PACKET; THE "PORT OF

STOCKTON," A LOFTY PADDLE WHEELER; A THREE-MASTED SCHOONER, THE "CHARLES R. WILSON"; AND, OF COURSE, THE "GJOA" IN WHICH THE DISTINGUISHED NORWEGIAN EXPLORER ROALD AMUNDSEN SAILED THE NORTHWEST PASSAGE BETWEEN 1903 AND 1905.

MAYOR ROBINSON SAID THE MARITIME MUSEUM WOULD SUPPLEMENT THE ENTIRE AQUATIC PARK AREA AND WOULD BELONG TO ALL SAN FRANCISCANS.

PLAN OF FINANCING

HE EVEN SUGGESTED THE PLAN MIGHT BE FINANCED BY POPULAR SUBSCRIPTION SO THAT THE MUSEUM WOULD BE IN A VERY REAL SENSE A COMMUNITY GESTURE.

IN THE OPINION OF MAYOR ROBINSON, IT WOULD NOT BE TOO DIFFICULT TO BRING THE HISTORIC OLD SHIPS TO THE AQUATIC PARK. MANY OF THEM ARE BEACHED OR TIED UP IN WEST COAST HARBORS AND NEED ONLY MINOR REPAIRS.

THE MATILDA NOW RESTS ON THE MUD AT ALVISO. SHE WAS BUILT IN 1905 AND WAS ONE OF THE LARGEST SCOW SCHOONERS CARRYING HAY, GRAIN AND LUMBER FROM SAN FRANCISCO TO THE INLAND WATERWAY PORTS.

MAYOR ROBINSON SAID THE ONCE-PROUD KAIULANI NOW IS A COAL BARGE IN THE PHILIPPINES.

"SHE IS THE LAST AMERICAN-BUILT SQUARE-RIGGED MERCHANT SHIP IN EXISTENCE AND DESERVES PRESERVATION AS A NATIONAL MONUMENT."

BUILT IN 1899

THE KAIULANI WAS BUILT IN 1899 FOR A SAN FRANCISCO SHIPPING FIRM AND SAILED OUT OF THE GOLDEN GATE FOR 45 YEARS. THE MAYOR SAID HE HAD BEEN INFORMED SHE COULD BE EASILY RIGGED AND RESTORED FOR A MUSEUM.

THE CITY OF PAPEETE NOW LIES ON THE MUD FLATS OFF CHINA CAMP IN MARIN COUNTY. HER BOW IS DAMAGED BUT COULD BE REPAIRED AT LITTLE COST, IT IS BELIEVED.

SHE WAS LAUNCHED IN 1883 AND PLIED THE SOUTH SEAS-CALIFORNIA TRADE ROUTES FOR 50 YEARS.

FROM THE SAN FRANCISCO CHRONICLE, DEC. 12, 1949

THE IMPLACABLE HAS GONE

BY JOHN R. STEVENS

THE LATEST PICTURE OF THE IMPLACABLE, BUILT 1790-1800, I HAVE SEEN WAS IN THIS WEEK'S "TIME" (WEEK OF THE 11TH.) IT SHOWS HER WITH QUARTER DECK AWASH, JUST ABOUT TO GO UNDER. TO THINK THAT THIS SHIP, OF WHICH THE PHYSICAL CONDITION WAS DESCRIBED AS COMPLETELY ROTTEN, REMAINED AFLOAT THREE HOURS, AFTER HAVING HER BOTTOM BLOWN OUT AND AFTER BEING RAMMED BY A TUG. IT ALMOST SEEMS TO ME THAT HER CONDITION WAS NOT AS BAD AS IT WAS MADE OUT, AND THAT THE COMMITTEE WAS INFLUENCED TO MAKE AN UNFAVORABLE REPORT.

IT MAY INTEREST THE GUILD TO KNOW THAT, AT THE TIME OF HER DESTRUCTION SHE WAS THE OLDEST FLOATING WARSHIP. SHE WAS LAID DOWN AT ROCHEFORT IN 1797 AND WAS NAMED IN 1795 THE DUGUAY TROUIN WHILE ON THE STOCKS. A LACK OF FUNDS DELAYED COMPLETION, SO THAT SHE WAS NOT LAUNCHED UNTIL MARCH 25TH, 1800. SO THIS MEANS THAT ALTHOUGH NOT IN THE WATERS SO EARLY AS THE CONSTITUTION, SHE WAS IN THE PLANNING STAGES. CONTRASTED WITH THE VICTORY AND THE CONSTITUTION, SHE WAS ALMOST IN HER ORIGINAL CONDITION. THE STERN SURVIVED A CENTURY AND A HALF WITH THE APPEARANCE IT HAD IN THE BEGINNING. THE ORIGINAL FRENCH DRAWINGS FOR THE STERN AND GALLERIES EXIST TO VERIFY THIS.

A BRITISH PLAN OF THE SHIP SURVIVES, SHOWING A PROPOSAL TO REBUILD HER STERN ON A DIFFERENT DECORATIVE SCHEME IN 1815, WHICH, FORTUNATELY, WAS NEVER CARRIED OUT. HER BOWS WERE, OF COURSE, REBUILT TO CONFORM TO THE ENGLISH USAGE, BUT THE FIGUREHEAD SEEMS TO HAVE BEEN REPLACED ON ITS NEW SETTING. THE ORIGINAL FRENCH IRONWORK ON HER CHANNELS WAS NEVER REPLACED. ANOTHER FEATURE IS THAT WHILE THE VICTORY HAD BEEN FLUSHED - PLANKED WITHOUT SHEER IN HER REBUILT OF 1812, THE IMPLACABLE SHOWED THE PROMINENT SHEERED WALES OF HER ORIGINAL BUILDING DATE.

ALL THE CARVINGS OF THE STERN AND GALLERIES WERE REMOVED PRIOR TO THE SHIP'S DESTRUCTION, ALONG WITH THE FIGUREHEAD, AND A GOOD DEAL OF HER FITTINGS. THE STERN IS TO BE REBUILT WITHIN THE NATIONAL MARITIME MUSEUM, WHERE THE STERN CABIN OR "WARD ROOM" IS TO ACT AS AN ANTEROOM TO THE ENTRANCE. THE INSPIRATION FOR THIS DERIVES FROM THE STERN OF THE SWEDISH YACHT AMPHION OF C. 1780 WHICH IS PRESERVED IN THE SAME WAY.

SCOW-SLOOPS

ANSWER TO QUERY NO. 48 OF HARRY ERSKINE BY ROBERT B. APPLEBEE

IN REPLY TO THE QUERY BY HARRY E. ERSKINE ABOUT THOSE LARGE HANDY, EFFICIENT, ONE-MASTED CARGO VESSELS CALLED SLOOPS OF PENOBSCOT BAY, IN MAINE, IN MY COMPILATION OF PORTLAND-FALMOUTH BUILT VESSELS, FROM 1850 TO 1900 I HAVE 37 OF THIS TYPE OF VESSEL LISTED AND AS MANY OR MORE WERE BUILT IN THE PENOBSCOT BAY AREA.

EACH AREA IN MAINE PRODUCED ITS SLOOPS AND IF THE MEMBERS WANT I SHALL SUBMIT A RECORD FROM MY COMPILATION OF THE ENTIRE NUMBER OF SLOOPS BUILT IN THE PORTLAND-FALMOUTH AREA OR ANY OF THE OTHER AREAS OF MAINE OF WHICH I HAVE MADE A RECORD OF VESSELS BUILT. IN THE PORTLAND-FALMOUTH AREA THESE SLOOPS VARIED IN SIZE FROM THE QUI VIVE OF 8 TONS BUILT AT PORTLAND IN 1876 TO THE M. M. HAMILTON OF 111 TONS BUILT IN HARPSWELL IN 1869. OF THE LARGER SLOOPS BUILT IN THIS AREA THERE WERE: STEPHEN ORE, 73 TONS, BUILT HARPSWELL 1859, YANKEE GIRL, 87 TONS, BUILT HARPSWELL IN 1866, UNITED STATES, 68 TONS BUILT WESTBROOK IN 1868, RIVERSIDE, 76 TONS BUILT YARMOUTH IN 1870, ALLETTA M. HAMILTON, 97 TONS BUILT PORTLAND IN 1873.

WHEN I SIT AND RECALL EVENTS OF THE PORTLAND-FALMOUTH AREA IN MAINE THERE ARE TWO SLOOPS THAT STAND OUT IN MY RECOLLECTION, ONE WAS A VERY SMALL SLOOP THAT WAS OWNED AND SKIPPERED BY CAPTAIN GOUDY AND SHE WAS USED IN THE INTER-ISLAND TRADE IN CASCO BAY. THE OTHER WAS THE UNITED STATES THAT CARRIED STONE FOR THE SACO, ME., BREAKWATER IN 1913 AND 1914. THE M. M. HAMILTON WAS IN ACTIVE SERVICE IN THE 1930'S AND THE ALLETTA L. HAMILTON WAS ABANDONED IN 1924.

MOST ALL OF THIS TYPE OF VESSEL WERE DESIGNED FOR THE STONE TRADE, OR ANY OTHER TRADE THAT CALLED FOR A LARGE DECKLOAD AND IN THE STONE TRADE THEY OFTIMES LOADED AT THE PENOBSCOT BAY QUARRIES, OR AS HARRY ERSKINE SAYS, AT THE SAWDUST PILES, AND CARRIED ABOUT ALL OF THEIR CARGO ON DECK. THEY WERE, OF COURSE, ONE-MASTED AND WHAT A STICK THEY CARRIED, WHAT A MAINSAIL, SOME OF THEM CARRIED A JIB BUT I HAVE SEEN MANY OF THEM WITH JUST ONE SAIL AND THE MAST WAS USED AS A DERRICK MAST IN UNLOADING.

SOME YEARS AGO, OR SHOULD I SAY MANY YEARS AGO FOR IT WAS IN THE VERY EARLY 1920'S, I SAW A LARGE SLOOP LOADING PILING AT ST. JOHN, N. B. FOR NEW YORK AND SHE MUST HAVE BEEN OVER 100 TONS. WHEN ONE CONSIDERS HOW LITTLE UNDERDECK TONNAGE ANY OF THEM HAD THEY CAN WELL REALIZE THAT THEY MUST HAVE BEEN LONG, BROAD OF BEAM AND OF SHALLOW DEPTH. OF THE PORTLAND-FALMOUTH BUILT SLOOPS THE ALLETTA L. HAMILTON, M. M. HAMILTON AND THE UNITED STATES ARE THE MOST OUTSTANDING, THE M. M. HAMILTON, THE LARGEST, WAS OF 111 TONS WITH A LENGTH OF 84.8, A BREADTH OF 26.3 AND A DEPTH OF 7.2., AND THESE THREE LARGER ONES LOADED FOR ANY PORT WHILE THE SMALLER SLOOPS CATERED TO THE INTER-ISLAND TRADE OF CASCO BAY. I HAVE OFTEN HEARD THEM CALLED THE "LOWLY STONE SLOOP" BUT THEY HAD THEIR PLACE IN THE EARLY TRADE OF THE COUNTRY AS DID THE CLIPPER SHIP AND THE SKIPPER OF ONE WAS UNDOUBTEDLY AS PROUD OF HIS RECORD AS WAS THE MASTER OF A TEA CLIPPER. TRUE THEY WERE A MUCH SLOWER MOVING VESSEL, BUT THE MASTER CONSIDERED HIS CARGO, THE WEATHER, THE WIND, THE TIDE, AND WHEN LOADED WITH STONE HE SLIPPED FROM PORT TO PORT, FROM HARBOR TO HARBOR UNTIL HE REACHED DESTINATION FOR IF HE ENCOUNTERED HEAVY WEATHER, WHEN LOADED WITH STONE, THERE WAS BUT ONE DESTINATION.

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VOLUME III JANUARY 1950 NUMBER I

THE BELL OF THE SANTA CLARA

BY

GORDON GRANT

IN THE DECEMBER SECRETARY'S LETTER YOUR ALLUSION TO THE SAD FATE OF THAT FINE OLD DOWN EASTER SANTA CLARA, NOW LYING A FORLORN SPECTACLE AT LONG BEACH, CALIFORNIA, RECALLED A PLEASANT INCIDENT BACK IN 1927. THAT WAS THE YEAR IN WHICH THE ALASKA PACKERS COMPANY RETIRED THE OLD SHIP FROM ACTIVE SERVICE, AND MR. TIMSON, PRESIDENT OF THE COMPANY, WROTE ME IN JANUARY, SAYING HE WAS CONSIDERING AN OFFER FOR THE SANTA CLARA FROM THE ATLANTIC COAST AND ADDED THAT HE WOULD BE GLAD TO SIGN ME ON AS SUPERCARGO FOR THE CAPE HORN PASSAGE IF THE IDEA APPEALED TO ME.

MR. TIMSON, A SENTIMENTAL MAN, DISLIKED THE IDEA OF SAILING SHIPS BEING TOWED THROUGH THE PANAMA CANAL. TO BE THE OWNER OF THE LAST AMERICAN BUILT SHIP TO ROUND THE HORN MADE A POTENT APPEAL TO HIM AND HIS ASSOCIATES. I ACCEPTED BY WIRE, AND AS THE PLAN WAS TO SAIL IN SEPTEMBER, I NEED HARDLY ADD THAT THE SUMMER DRAGGED SLOWLY BY.

IN AUGUST MR. TIMSON WROTE: "THE SALE OF THE SHIP TO THE NEW YORK MAN HAS FALLEN THROUGH, UNFORTUNATELY, AND WE HAVE SOLD HER TO SOME MOVING PICTURE PEOPLE IN SAN PEDRO. AS I AM CONVINCED THAT HER NEW OWNERS DON'T KNOW A SHIP'S BELL FROM A TROLLEY GONG, I AM SENDING YOU SANTA CLARA'S POOP BELL, AS I KNOW YOU WILL TREASURE IT. I CAN ONLY HOPE SHE WILL NOT BE BURNED AT SEA MAKING A THREE REEL COMEDY"...

SO THE SANTA CLARA'S BELL NOW HAS AN HONORED PLACE IN MY STUDIO, WHERE ITS SILVER NOTE IS SOMETHING TO HEAR. INCIDENTALLY I HAVE WILLED IT TO THE MARINE MUSEUM OF THE CITY OF NEW YORK.

VOLUME III JANUARY 1960 NUMBER 1

ANSWER TO QUERY NO. 59 OF KARL KORTUM — THE SANTA CLARA — BY ROBERT A. NASH. REGARDING THE SANTA CLARA - A SUBJECT OF DEEP PERSONAL INTEREST. I HAVE BEEN DOWN THERE AT LEAST FOUR TIMES THIS YEAR AND ARTHUR RUDD WAS THERE ABOUT TWO WEEKS AGO - NO SIGN OF ANYTHING HAPPENING YET. I GUESS THE MAN WHO WAS GOING TO SALVAGE HER GAVE UP. I HAVE SOME NOTES ON THE HISTORY OF HER THAT YOU CAN HAVE.

ANSWER TO QUERY NO. 66, THE TWAKOW BY ROBERT A. NASH. "THE TWAKOW" BY WILLIAM MAXWELL BLAKE WAS PUBLISHED IN YACHTING IN DECEMBER, 1929. THE PLANS PUBLISHED WITH THIS ARTICLE ARE TO A VERY REDUCED SCALE AND AN ENLARGEMENT OF THEM IS BEING SENT TO MR. HONEY. THERE WERE TWELVE ARTICLES IN THIS SERIES THAT COMMENCED IN DECEMBER, 1928 AND RAN UNTIL JANUARY, 1930. THE TWAKOW IS A TYPE OF JUNK COMMONLY SEEN AT SINGAPORE AND THEY ARE PROBABLY THE MAIN CARGO CARRIERS OF THAT PORT. I THINK THE STERN IS USUALLY PAINTED WHITE ON THESE CRAFT, BUT THIS IS A POINT THAT I AM NOT SURE OF ALTHOUGH I RECALL SEEING MANY OF THEM AT SINGAPORE.

QUERY NO. 67 BY THOMAS HORNSBY, THE CHAMPION OF THE SEAS AND THE AUSTRALIAN COAT OF ARMS ON HER ESCUTCHEON. SEVERAL YEARS AGO, I BOUGHT ON SPECULATION AN EXQUISITE MODEL OF THIS SHIP. SHE WAS IN NEED OF REPAIR AND BEFORE I STARTED ON HER I LOOKED HER UP AND FOUND A DESCRIPTION OF HER IN "CLARK'S CLIPPER SHIP ERA", "CUTLER'S GREYHOUNDS" AND "CLIPPER SHIPS" BY LA GRANGE. ALL MENTIONED A FIGUREHEAD OF A SUNDAY SAILOR WITH HIS HAT IN HIS RIGHT HAND AND HIS LEFT HAND EXTENDED, AND ON HER STERN THEY STATED SHE CARRIED THE COAT-OF-ARMS OF AUSTRALIA. WELL, I DREW A SKETCH OF A A SAILOR AND THEN REDUCED IT TO SCALE AND MADE IT IN ENGLISH BOXWOOD. COULDN'T HAVE LOOKED BETTER. THE COAT-OF-ARMS HOWEVER WAS THE PROBLEM. I WENT TO THE LIBRARY AND I GOT OUT EVERY BOOK ON HERALDRY ON TOWNS, CITIES, PROVINCES, COUNTRIES, STATES, AND WHAT HAVE YOU. I FOUND THAT THERE WAS NO SHIELD FOR AUSTRALIA FOR THAT PERIOD, 50'S AND 60'S, AND THAT THE MOTTO AND SHIELD WAS NOT ASSIGNED UNTIL 1908. WELL, I WASN'T GOING TO LET A LITTLE THING LIKE THAT STOP ME — I WROTE TO THE AUSTRALIAN LEGATION AND HERE IS WHAT THEY TOLD ME: THE FEDERATION OF AUSTRALIAN STATES DID NOT TAKE PLACE UNTIL 1901, AND FOR THE PERIOD ABOUT WHICH I HAD INQUIRED, AUSTRALIA CONSISTED OF SIX BRITISH COLONIES WHICH WERE A GEOGRAPHICAL, BUT NOT A POLITICAL ENTITY. THEY ALL HAD THEIR OWN ARMS. NOW CLARK WAS UNDOUBTEDLY WRONG, AND EVERYONE WHO HAS USED THE SAME DESCRIPTION ABOUT THE ARMS ON THE STERN IS WRONG ALSO. I NEVER DID FIND WHAT PORT THE CHAMPION OF THE SEAS WENT INTO, MELBOURNE, SIDNEY OR BRISBANE AND IT MIGHT BE POSSIBLE THAT SHE CARRIED THE ARMS OF ONE OF THESE CITIES OR DISTRICTS BUT SHE COULD NOT HAVE HAD THE AUSTRALIAN ARMS ON HER STERN. IS THERE A SOLUTION TO THIS?

QUERY NO. 68 FROM HERBERT G. SCOTT - JOE LANE. DID THE JOE LANE, U. S. REVENUE CUTTER, HAVE EITHER BOATS, BINNACLE OR GUNS? WHAT TYPE AND WHERE LOCATED.

QUERY NO. 69, THE NAUTICAL MEANING OF THE WORD "FINE" FROM CHARLES F. H. MENGES. THE FOLLOWING IS AN EXTRACT FROM ONE OF MY GRANDFATHER'S LETTERS WRITTEN IN 1865 — "I HAD THE DENCY ON THE BLOCKS AT EAST BOSTON TO FIX HER "FINE", WHICH HAS BEEN ACCOMPLISHED TO MY SATISFACTION. I FOUND HER "FINE" IS BETTER ORDER ON THE WHOLE THAN I HAD ANTICIPATED, STILL IT WILL COST 75 DOLLARS." WHAT IS THE MEANING IN THIS CONNECTION OF THIS WORD "FINE"?

QUERY NO. 70, CAPT. COOK'S SHIP FROM JOY BUBA. WHERE CAN I LEARN MORE ABOUT CAPT. COOK'S SHIP THAT ALAN VILLERS, IN HIS "CORAL SEA" SAYS IS ROTTING IN THE MUD OF NEWPORT, RHODE ISLAND HARBOR?

INTRODUCING A LADY MEMBER, MRS. JOY BUBA, 61 EAST 57TH ST. NEW YORK 22, N.Y. FROM THE LIST OF MRS. BUBA'S NAUTICAL INTERESTS ONE WOULD JUDGE HER TO BE A TRUE MEMBER OF THE GUILD. TO MENTION A FEW: SHIP BOOKS, SHIP PICTURES, HISTORY OF CARGO AND EXPLORATION VESSELS, GERMAN P SHIPS, WHALERS, CLIPPERS, WHEREABOUTS OF OUR REMAINING SQUARE RIGGERS, "EVEN HULKS" AND CHANTEYS. WE LEARN FROM ANOTHER THAT MRS. BUBA IS A WELL KNOWN ARTIST AND SCULPTRESS WHO HAS PAINTED SOME OUTSTANDING PORTRAITS

OF OUR MOST FAMOUS MEN, REMODELLED DINOSAURS, PUBLISHED MANY BOOKS ON NATURAL HISTORY AND PAINTED SCENES FOR THE AMERICAN NATURAL HISTORY MUSEUM OF NEW YORK. TO TOP IT ALL MR. AND MRS. BUBA SAIL THE WATERS OF THE SOUND IN THEIR 16 FT. SLOOP.

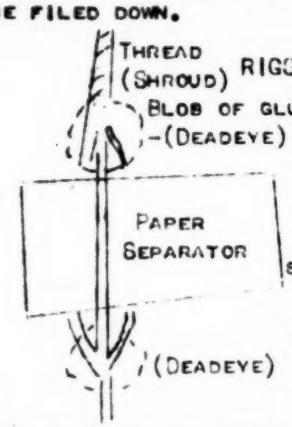
WOODEN ANCHORS FOR SHIP MODELS
FROM THE SHOP OF HARRY ECKSTEIN

DURING THE THIRTY-ODD YEARS THAT I HAVE BEEN SHIPMODELLING I HAVE NEITHER INVENTED ANY GADGETS WORTH MENTIONING NOR PUT TO USE THE MANY I HAVE SEEN OTHERS USE OR DESCRIBE FOR THE SIMPLE REASON THAT I AM A SLOW MODELLER WHO JUST LOVES THE WORK AND AM NEVER IN A HURRY TO GET FINISHED, BECAUSE I WILL THEN JUST START BUILDING ANOTHER ONE. I JUST DON'T MIND DOING THINGS THE HARD WAY. DICK LAWTON AND SOME OTHER MODELLERS HAVE BEEN SURPRISED TO LEARN THAT THE ANCHORS FOR MY MODEL ARE MADE OF WOOD. WELL, I SEARCHED ALL OVER FOR SUITABLE READY-MADE ONES BUT COULDN'T FIND ANY THAT WERE THE RIGHT TYPE AND LENGTH SO I SCALED DOWN A DRAWING OF ONE OF THE CONSTITUTION'S ANCHORS AND MADE ONE OUT OF BOXWOOD. I PAINTED IT WITH THE PAINT USED FOR MODEL LOCOMOTIVES AND IT TURNED OUT TO BE SO SATISFACTORY AND INDISTINGUISHABLE FROM A METAL ONE THAT I MADE ITS MATE THE SAME WAY AND WILL ALSO MAKE A SHEET AND KEDGE. WHAT AT FIRST THREATENED TO BE A TOUGH PROBLEM TURNED OUT TO BE A PLEASANT ACCOMPLISHMENT.

MAST HOOPS AND RINGS
BY R. F. SEWALL

AN EASY METHOD FOR MAKING MAST HOOPS IS TO GET A SMALL ROLE OF GUMMED PAPER SUCH AS IS USED ON CORRUGATED CARTONS. WET A SMALL LENGTH OF IT AND WRAP IT AROUND A DOWEL OF THE DESIRED DIAMETER. KEEP THE FIRST LAP DRY. WRAP SEVERAL LAYERS UNTIL YOU GET THE THICKNESS YOU NEED FOR THE HOOP. USE A SAFETY RAZOR BLADE AND CUT OFF THE RINGS AT THE WIDTH DESIRED. YOU MAY SCRAP A FEW. THE MANILLA PAPER IS ABOUT THE COLOR OF THE NATURAL WOOD — SHELLAC. RINGS OF ANY SIZE ....WRAP A FLEXIBLE TINNED WIRE ABOUT A NAIL OR A BRAD OF THE DESIRED SIZE ..TAKE A LOT OF TURNS..FASTEN IT SECURELY AND MAKE A QUICK SWIPE OF SOLDER THE LENGTH OF THE COIL. MAKE THIS SOLDER AS NARROW AS YOU CAN. CUT OFF ONE RING AT A TIME,..EVERY OTHER RING WILL BE SCRAPPED. THE RING WILL BE DOUBLED AT THE JOINT FOR A SHORT DISTANCE BUT THIS CAN BE FILED DOWN.

RIGS, JIGS AND GADGETS FROM THE SHOP OF H. V. EVANS



A SUGGESTED METHOD OF MAKING SHROUDS AND DEADEYES ON SMALL SCALE MODELS: USE THREAD OF CORRECT SIZE AND COLOR AND STRETCH IT WELL BEFORE USE. UNRAVEL LENGTH OF THREAD CORRESPONDING TO DISTANCE BETWEEN DEADEYES, HOLDING YARNS APART WITH PINS OR BY THREADING A PIECE OF PAPER THROUGH AS SHOWN IN SKETCH. PUT A SMALL BLOB OF GLUE TO REPRESENT DEADEYES.

STEPPING MASTS ON VERY SMALL SCALE MODELS....TO ENSURE THAT MASTS ARE ERECTED AT CORRECT ANGLE, DRILL A SMALL HOLE IN THE BUTT OF THE MODEL'S MAST, WHICH IS CUT OFF AT DECK LEVEL, AND A CORRESPONDING HOLE IN THE CORRECT PLACE ON DECK. A SHORT LENGTH OF COPPER WIRE INSERTED IN BOTH MAST AND DECK WILL ENABLE THE RIGGING TO BE ADJUSTED UNTIL THE CORRECT ALIGNMENT IS OBTAINED.

ROSTER OF GUILD MEMBERS

WITH THIS ISSUE, YOU WILL RECEIVE THE ROSTER OF THE NAUTICAL RESEARCH GUILD TO JANUARY 1960. THE ADDRESS OF EACH NEW MEMBER WILL BE GIVEN WITH HIS INTRODUCTION AS IN THE PAST. WE KNOW THE ADVANTAGES OF INTER-MEMBER CORRESPONDENCE, IT IS ONE OF THE PRIME REASONS FOR OUR ORGANIZATION. WE SUGGEST AGAIN THAT COPIES OF THE MOST INTERESTING MATERIAL BE SENT TO THIS OFFICE FOR INCLUSION IN OUR PUBLICATIONS FOR THE BENEFIT OF ALL.

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THE PAGES OF JOURNAL AND LETTER ARE FOR GUILD MEMBERS TO "LET OFF STEAM", PROMOTE THEIR PET THEORIES AND DISCUSS PRO AND CON THEIR NAUTICAL PROBLEMS. WE CAN ONLY ARRIVE AT CONCLUSIONS BY SINCERE DISCUSSION. ALL MEMBERS ARE PRIVILEGED TO WRITE THEIR VIEWS AND OPINIONS; BUT THIS DOES NOT NECESSARILY MEAN THAT THEY ARE THE VIEWS AND OPINIONS OF THE GUILD AT LARGE... MR. JAMES W. HARBIN, JR. WRITES — "THEY ARE STEPPING A NEW BOWSPRIT ON THE CONSTITUTION IN BOSTON. MATERIAL IS AVAILABLE BUT SKILLED LABOR TO ACCOMPLISH SAME IS VERY SCARCE....MR. HARBIN ALSO ADDS "I PERSONALLY DO NOT THINK THERE IS MUCH OF A CHANCE OF THE CONSTELLATION OR HARTFORD EVER BEING SCRAPPED AS LONG AS ONE SAILOR IS LEFT IN THE NAVY BRANCH OF THE DEPARTMENT OF DEFENSE...CAPT. LOBEZ SAYS THERE WERE ONLY TWO SHIPS BUILT WHICH HAD LANYARDS SET UP THROUGH THE BULWARKS, OR INBOARD AND THEY WERE THE CALIPH AND THE TORRENS....A MEETING WE WOULD ALL HAVE ENJOYED IS THE ONE HELD IN NOVEMBER BY THE THAMES SHIP LOVERS AND SHIP MODEL SOCIETY ON BOARD R.R.S. DISCOVERY, LT. CDR. J. H. ("JASON") CRAINE GAVE A TALK "1000 YEARS OF WHALING" WHICH WAS ILLUSTRATED BY LANTERN SLIDES.... SIXTEEN MEMBERS OF THE GUILD HAVE "SERVED IN SAIL"; IN EVERYTHING FROM 3 SKYSAIL YARDERS TO BRIGS, BARKS AND SCHOONERS. FOR FIRST HAND INFORMATION ON THE DETAILS AND RIGGING OF YOUR MODELS SEND IN YOUR QUERIES....THE "EAGLE OF THE SEA" BY BRUCE GRANT AND ILLUSTRATED BY GORDON GRANT IS NOW IN ITS SECOND PRINTING....HAVE JUST READ THE FIRST OF A SERIES BY WINTHROP PRATT, JR. IN THIS MONTH'S POPULAR SCIENCE, WHICH GIVES DETAILED INFORMATION AND SKETCHES ON THE MAKING OF MANY DIFFICULT PARTS OF SHIP MODELS....HAVE YOU A SUPPLY OF APPLICATION FORMS WHICH YOU WILL NEED TO ENROLL YOUR FRIENDS AND ASSOCIATES FOR 1950....THANKS TO THOSE WHO HAVE SENT THEIR 1950 DUES AND A REMINDER TO THOSE WHO HAVE NOT....WE HAVE HAD REQUESTS FOR MORE RIGS, JIGS AND GADGETS. ANOTHER SECTION WILL APPEAR SOON. PLEASE SEND IN YOUR SHOP NOTES WITH SKETCHES....ALSO SEND IN YOUR IDEAS AND SUGGESTIONS.....A PERSONAL NOTE OF THANKS TO THE MEMBERS WHO HAVE SENT ME THE BEAUTIFUL CHRISTMAS CARDS. MANY WITH THE PICTURES OF FAMOUS SHIPS WHICH I APPRECIATE GREATLY AND THEY WILL BE WELCOME ADDITIONS TO MY "FLEET" OF SHIP PICTURES. THANK YOU AND BEST WISHES FOR 1950....AGAIN, MY PERSONAL THANKS TO THE MANY MEMBERS WHO HAVE WRITTEN OUR ARTICLES, DRAWN OUR ILLUSTRATIONS AND TAKEN WHOLE HEARTED PART IN OUR EFFORT. WITHOUT THIS HELP THE GUILD WOULD NOT BE POSSIBLE.

HARRY D. HAMILTON

THE AFTERGUARD, NAUTICAL RESEARCH GUILD, SAN FRANCISCO

THE SAN FRANCISCO CHAPTER OF THE NAUTICAL RESEARCH GUILD HELD ITS REGULAR MEETING IN THE MAIN LOBBY OF THE SAN FRANCISCO YACHT CLUB AT BELVEDERE, CALIFORNIA, AT 8 P. M. TUESDAY, 15 NOVEMBER, 1949. CAPTAIN KORTAM REPORTED PROGRESS ON THE AQUATIC PARK NAUTICAL MUSEUM PROJECT. THAT MAYOR ROBINSON OF SAN FRANCISCO WAS HEARTILY IN FAVOR OF AND WORKING FOR IT. IT WAS SUGGESTED THAT THE FOLLOWING MEN BE CONTACTED TO ENDEAVOR TO SECURE THEIR HELP IN FURTHERING THE PROJECT: STEWART LEETE, MR. CUSHING (MATSON S.S. CO.), CAPTAIN MACDONALD, THOMAS CUFF, JOHN PIVER. SEVERAL VESSELS WERE DISCUSSED — THEIR RIGGING, BACKSTAYS, ETC., AMONG THEM THE ENGLISH CLIPPER TORRENS, THE ALABAMA, THE YOUNG AMERICA. MR. BERGER BROUGHT WITH HIM FOR THE AFTER GUARD'S INSPECTION, THE PLANS OF THE YOUNG AMERICA.

MR. BERGER BROUGHT UP THE DISCUSSION OF SHIPS HAVING A FULL HIGH POOP DECK, BUT HAVING A FORECASTLE DECK THAT WAS FLUSH WITH THE MAIN DECK RAIL. IT WAS THOUGHT THAT THE ALABAMA WAS SUCH A VESSEL.

CAPTAIN LOBEZ SUGGESTED THAT THE MEMBERS OF THE SAN FRANCISCO CHAPTER BE DESIGNATED AS "FELLOWS OF THE NAUTICAL RESEARCH GUILD", THAT GIVING THEM THE DEGREE OF "FELLOWSHIP", AS - CAPTAIN R. L. LOBEZ, F.N.R.G. IT WAS PUT TO A VOTE AND CARRIED UNANIMOUSLY. SO BE IT, HENCEFORTH A "FELLOW OF THE NAUTICAL RESEARCH GUILD".

THE NEXT MEETING WAS SET FOR THE EVENING OF 15 FEBRUARY, 1950 AT THE SAN FRANCISCO YACHT CLUB AT BELVEDERE COLE.

JAS. H. WILLEY - YOEMAN OF THE AFTERGUARD.

THE NAUTICAL RESEARCH GUILD
(A NON-PROFIT ORGANIZATION)

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